

Freeway Bottlenecks: Innovative Mitigation Strategies & Improved Modeling Approaches

NJDOT Research Showcase (West Windsor, NJ)

October 25th, 2017

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Presentation Objective

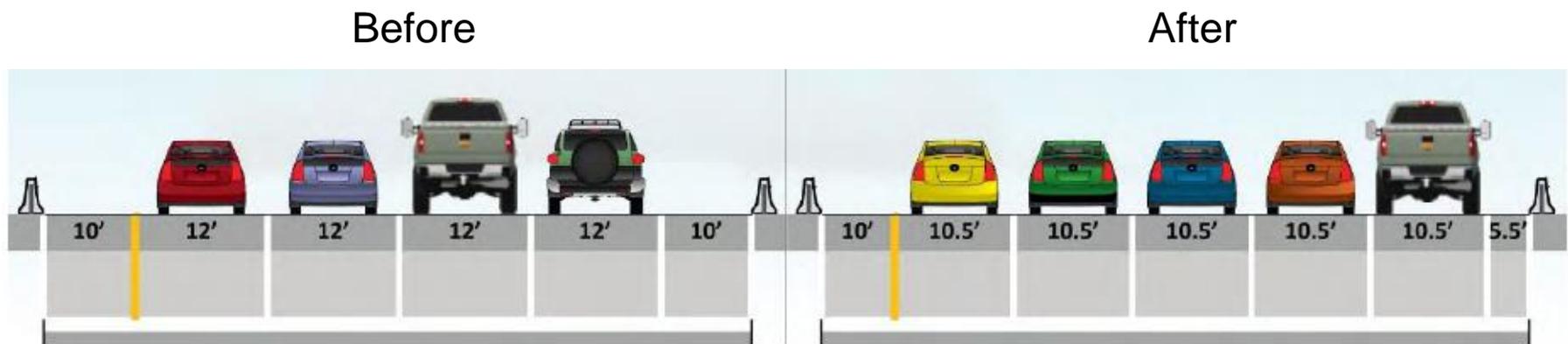
- Discuss three ongoing, related FHWA projects
 - Improved modeling of freeway bottlenecks
 - Innovative/emerging bottleneck mitigation strategies
 - Not requiring CAV technology
- Provide status update on all three projects
- Provide professional opinion on the likely outcomes
 - For all mitigation strategies and modeling approaches

Summary of Projects

- Narrowing of Freeway Lanes and Shoulders
 - 50% complete
- Alternative Designs for Merge/Diverge Areas
 - 20% complete
- Improved Simulation of Freeway Bottlenecks
 - Scheduled to start in November 2017

Project #1 Objectives

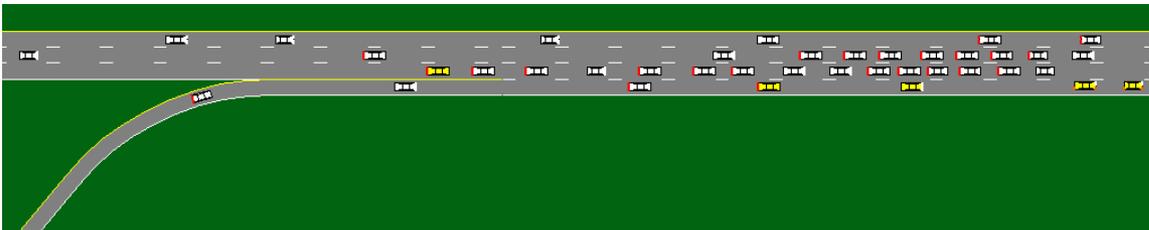
- Narrowing of Freeway Lanes and Shoulders
 - Collect data at real world sites
 - Update the HCM procedure
 - Update microsimulation tools
 - Multi-objective (operations & safety) recommendations



Neudorff, Jenior, Dowling, Nevers, FHWA-HOP-16-060, 2016

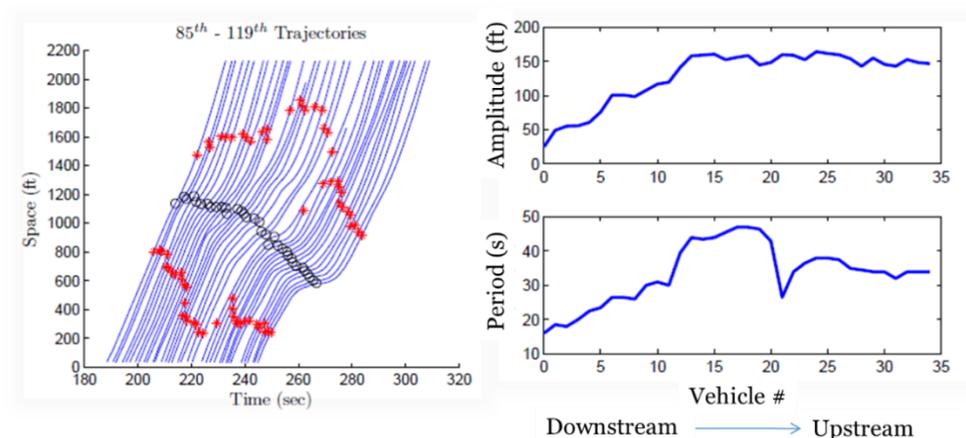
Project #2 Objectives

- Alternative Designs for Merge/Diverge Areas
 - Review merge/diverge issues at typical on/off-ramps
 - Review similar issues at managed (HOV/HOT) lanes
 - Come up with new (non-CAV) mitigation strategies
 - Conduct simulations to evaluate effectiveness



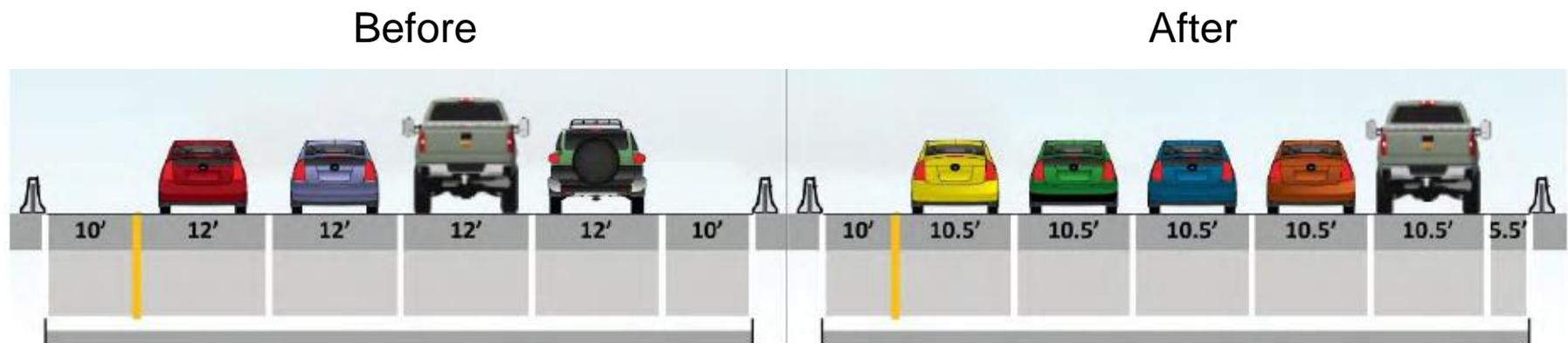
Project #3 Objectives

- Improved Simulation of Freeway Bottlenecks
 - Driver behavior believed to be different at bottlenecks
 - Collect data at real-world bottlenecks
 - Develop new car-following and lane-changing models
 - Old models will still be used in uncongested areas



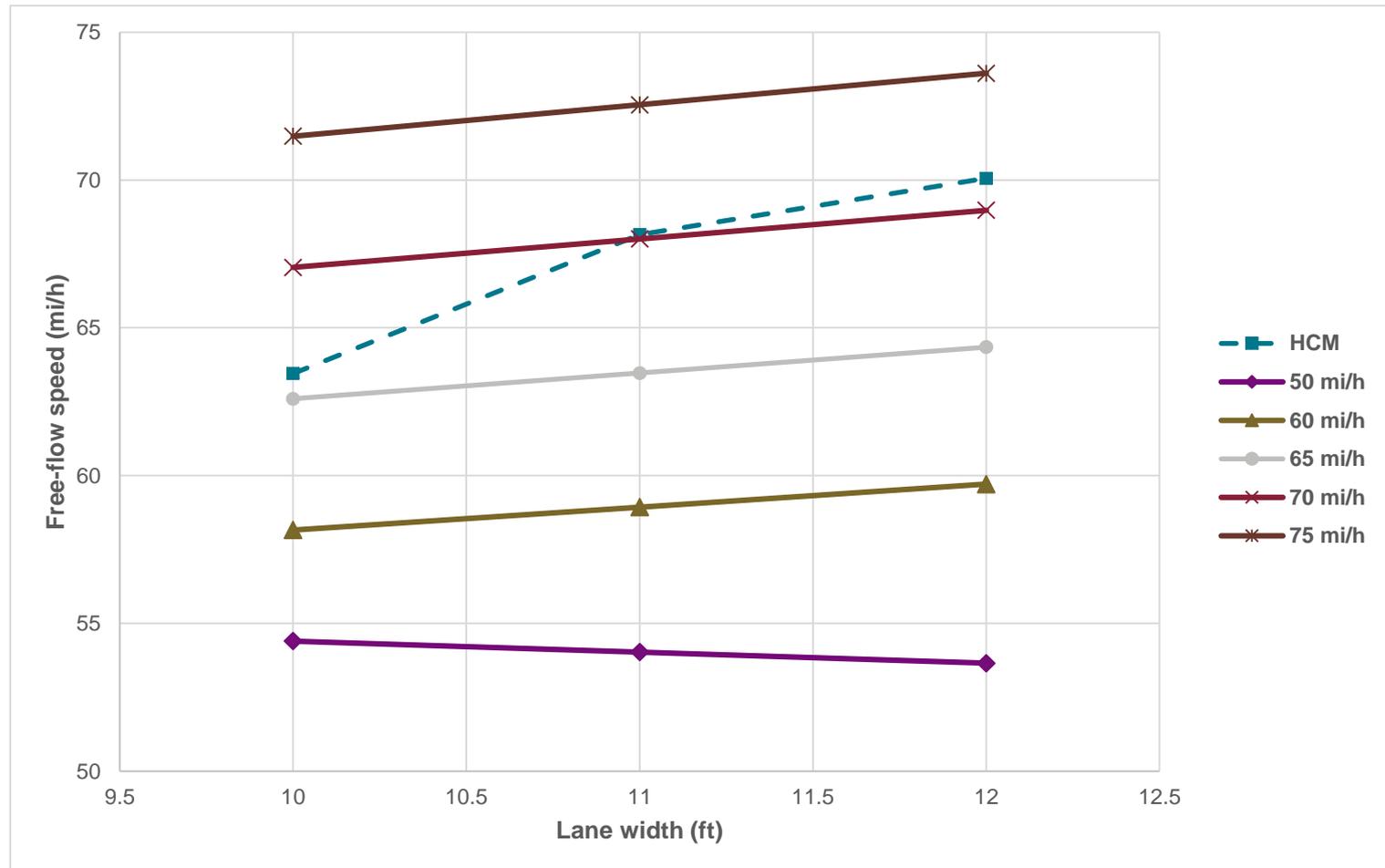
Project #1 Status Update

- Narrowing of Freeway Lanes and Shoulders
 - New models for the HCM
 - New models for safety prediction
 - Simulation models behind schedule
 - Drone videos, FAA approvals, machine processing



Neudorff, Jenior, Dowling, Nevers, FHWA-HOP-16-060, 2016

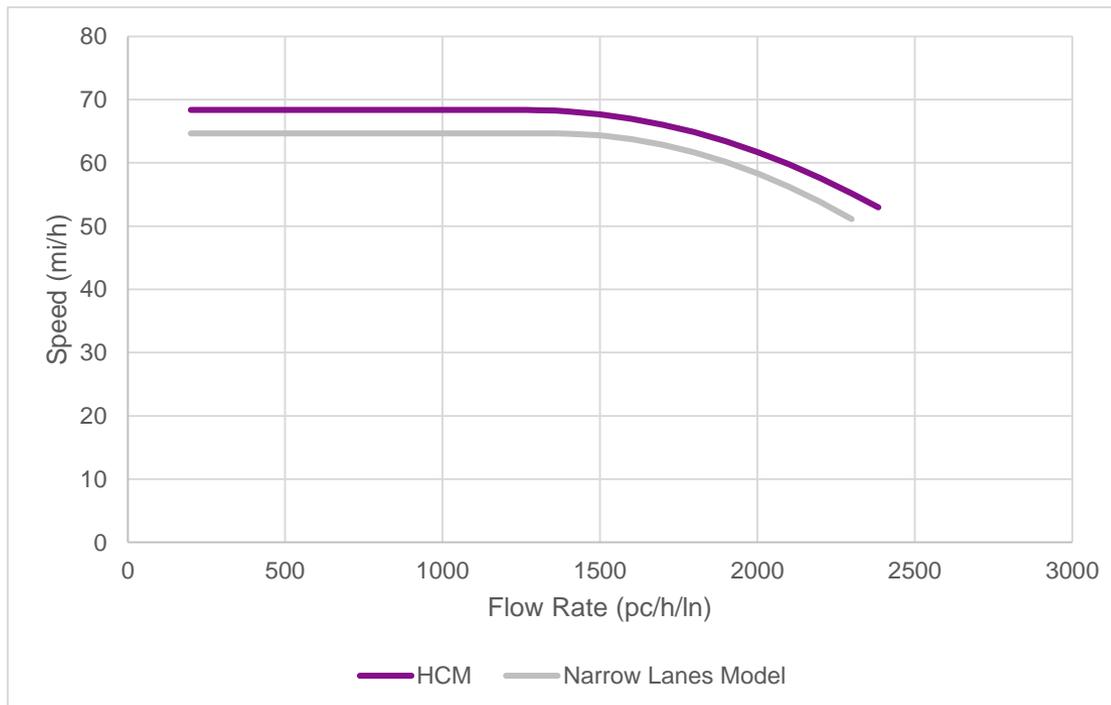
Project #1 Status Update



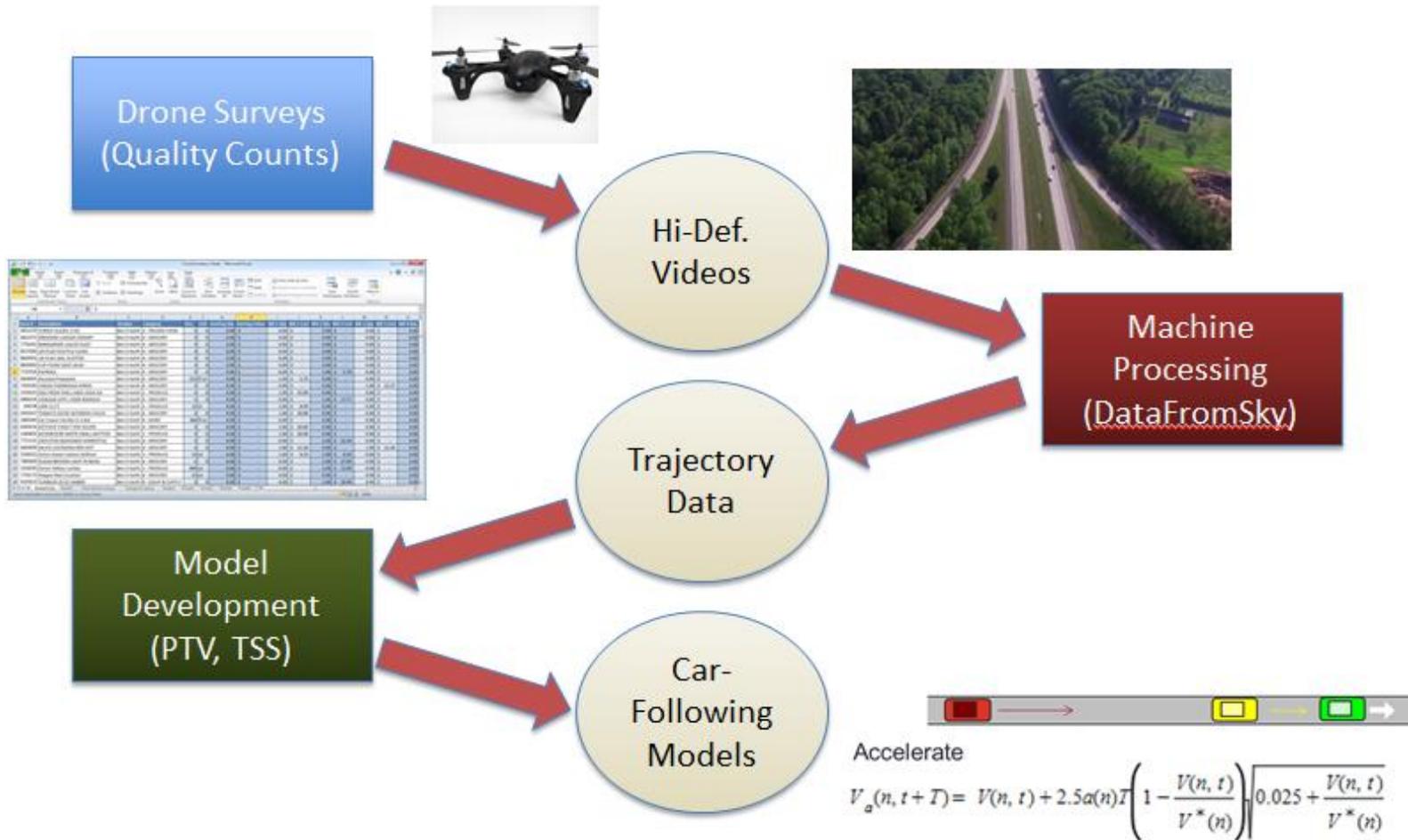
Project #1 Status Update

$$FFS = BFFS - f_{LW} - f_{RLC} - 3.22 \times TRD^{0.84}$$

$$FFS = 4.99 + 1.0982 \text{ Number of lanes} + 0.0833 \text{ Shoulder Width} + 0.9906 \text{ SL1} + 0.6964 \text{ SL2} \\ - 0.3744 \text{ Lane Width} + 0.0 \text{ Type_basic} - 1.6963 \text{ Type_diverge} - 1.1524 \text{ Type_merge} \\ + 0.01917 \text{ Lane Width} * \text{SL2} \quad (4)$$

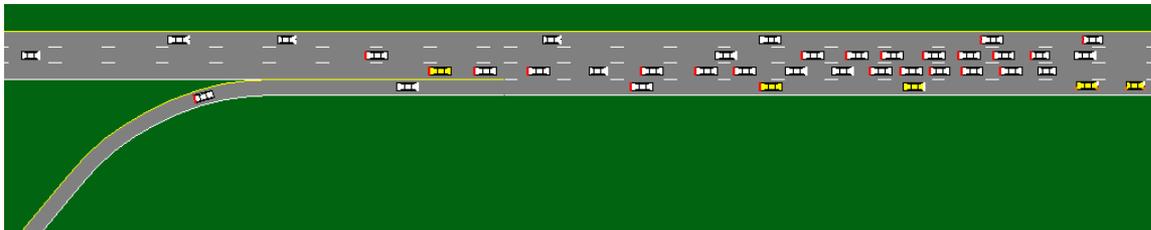


Project #1 Status Update



Project #2 Status Update

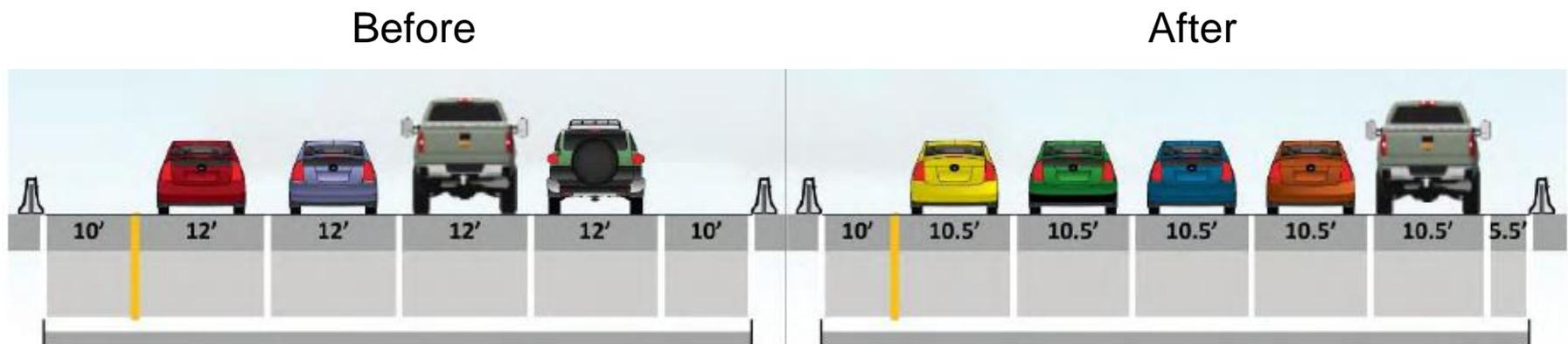
- Alternative Designs for Merge/Diverge Areas
 - Multiple merge points on accel/decel lanes
 - Speed optimization (e.g., dynamic calming devices)
 - Dynamic signal control (a.k.a., mainline metering)
 - Coordinated ramp metering (e.g., HERO)
 - Open-access managed lanes on the right
 - Managed lane access point optimization



Most Likely Outcomes (Professional Opinion)

Project #1 Likely Outcomes

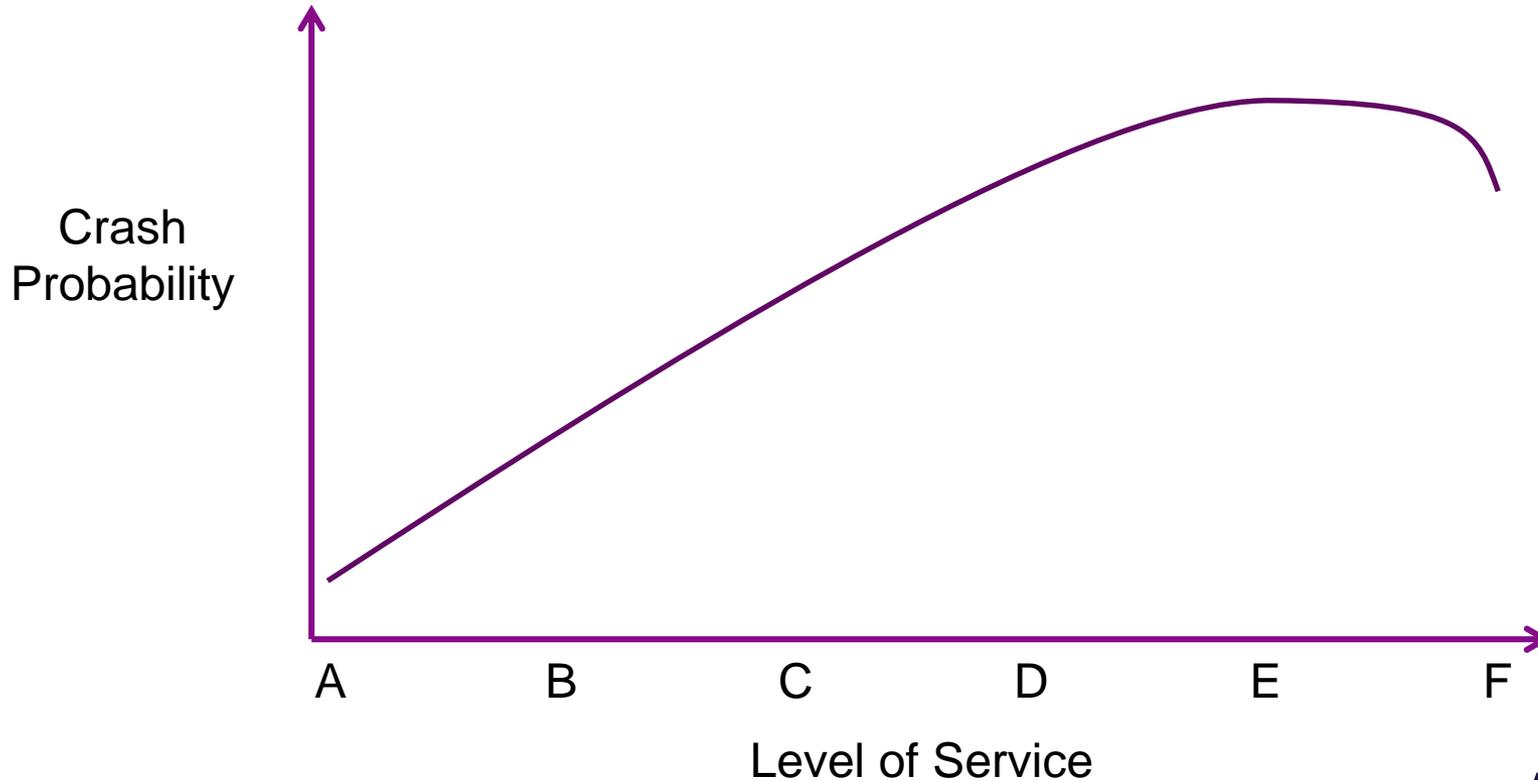
- Narrowing of Freeway Lanes and Shoulders
 - Safety won't be a deal-breaker (see next slide)
 - Minor changes to HCM & simulation models
 - Narrow lanes will be a cost-effective mitigation strategy
 - Dynamic lane narrowing technology may emerge



Neudorff, Jenior, Dowling, Nevers, FHWA-HOP-16-060, 2016

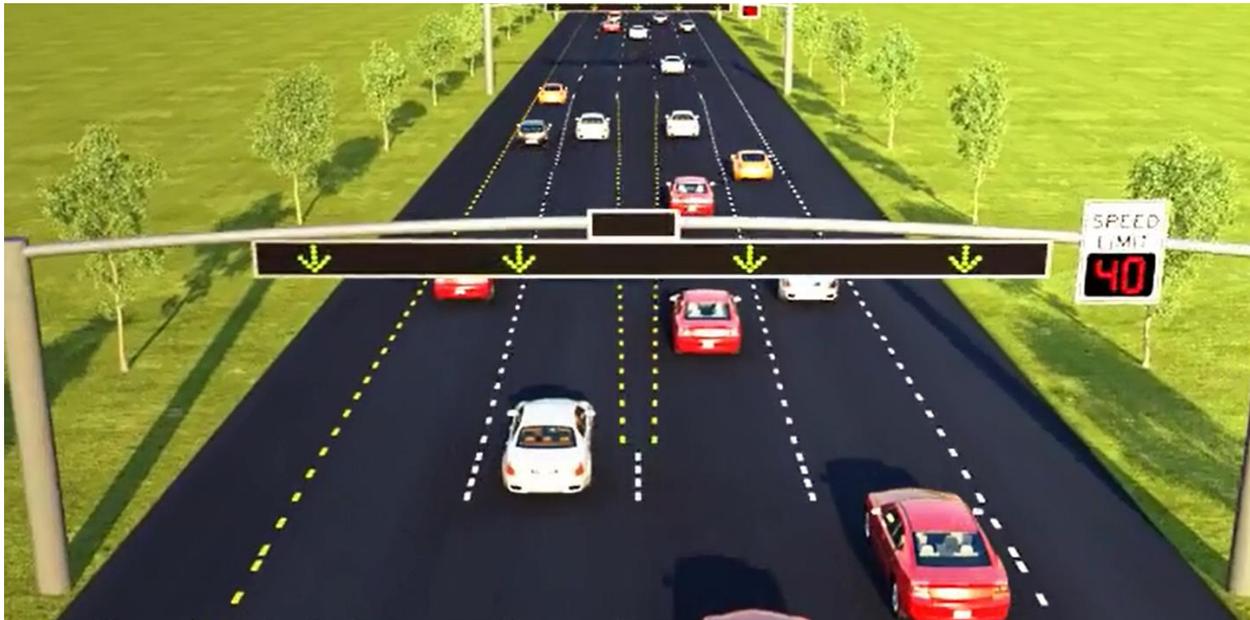
Project #1 Likely Outcomes

- F to E: accept slight crash increase to get moving again
- E to D: narrow lane risk cancelled out by reduced density



Project #1 Likely Outcomes

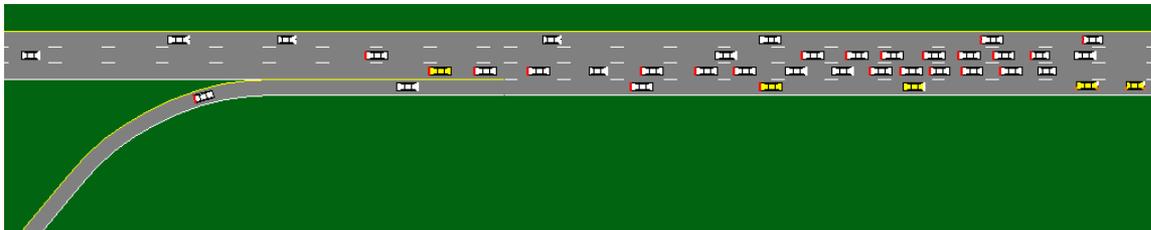
- Dynamic lane narrowing technologies may emerge
 - Revert to 12-foot lanes during off-peak periods



Source: SmartRoads, LLC

Project #2 Likely Outcomes

- Alternative Designs for Merge/Diverge Areas
 - Multiple auxiliary lane merge points: **limited application**
 - Dynamic traffic calming: **political challenges**
 - Dynamic signal control: **political challenges**
 - Coordinated ramp metering: **will find a niche**
 - Open-access ML on the right: **little benefit**
 - ML access point optimization: **insufficient data**

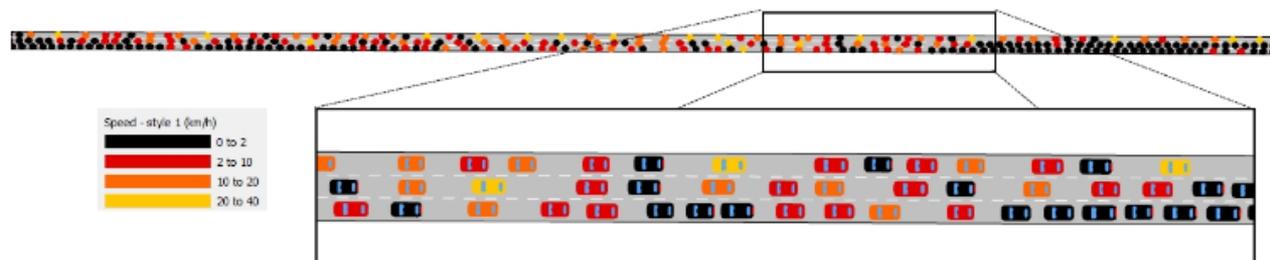


Project #3 Objectives

- Improved Simulation of Freeway Bottlenecks
 - Some tools will adopt multiple car-following models
 - Overall impact hard to predict
 - TSS-Aimsun already did this:

Car-Following model extension for congested highways

We've improved car-following in congested conditions by using a modified Gipps model to achieve more accurate simulated speeds.



<https://www.aimsun.com/aimsun/new-features/>

Final Predictions

- Methods that will gain traction
 - Static lane narrowing to add a freeway lane
 - Coordinated ramp metering
 - Alternate car-following models for bottlenecks
- Methods facing political headwinds
 - Dynamic lane narrowing technologies
 - Dynamic traffic calming devices on freeways
 - Dynamic signal control on freeways

Thank you

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